S'COOL BREEZE

Students' Cloud Observations On-Line

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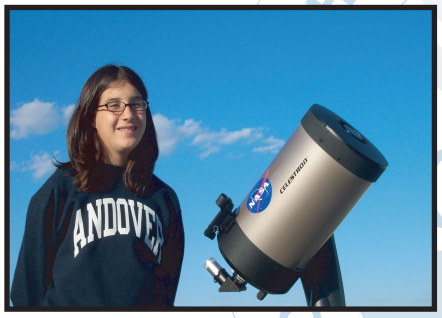
With One Eye on the Sky

By Katherine E. Lorentz, SAIC-Langley Research Center

Abigail Hoglund, 14, can't remember a time when she was not exploring and studying the world around her. Growing up in Neptune City, New Jersey, Abigail quickly became passionate about scientific inquiry with the help of her father, the manager of an engineering company and amateur astronomer. Some of her fondest memories include observing the beautiful skies while hiking and camping in Yellowstone and Acadia National Parks; stargazing with her 8" Schmidt-Cassegrain telescope; and going to science lectures at nearby Princeton University. Even as early as five years old, Abigail recounts the joy she felt in learning science "factoids" from a game given to her by her father.



Two years ago, as a seventh grader, she was introduced to researchers at NASA's Langley Research Center through the S'COOL program (Student's Cloud Observations On-Line). Dr. Lin Chambers, director of the S'COOL program and a senior research scientist at Langley Research Center, gave a presentation to Abigail's school, Hunterdon Christian Academy in Flemington, New Jersey. Abigail was pleasantly surprised to learn that Hunterdon was involved with NASA. She said, "I loved astronomy and all things NASA-related. [The S'COOL program] was an opportunity to help NASA!" Abigail knew that she couldn't pass up this opportunity to learn about NASA's Earth Science Enterprise and how Earth science could help her learn more about space science.

For two years, Abigail embraced the S'COOL program, observing clouds, studying Earth science, and even writing reports for her science classes. In a report that Abigail wrote on CERES, she said, "I have used my own observations to discover trends in climate. For instance, when I looked at temperature, relative humidity, persistent contrails, and short-lived contrails, I found (from a graph I constructed) that all of these values seem to be smaller in winter than in warmer months." Abigail hypothesized that "because the Sun is the natural cause of all weather, and since its rays shine more directly on the Earth (northern hemisphere) in fall and spring, contrails form more readily in summer, spring, and early fall than in winter and late fall."

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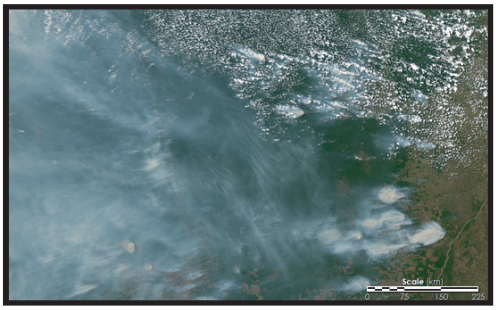
In this Issue:

Clouds are Cooler than Smoke

By David Herring, NASA Goddard Space Flight Center - Earth Observatory (Edited by Roberto Sepulveda)



Satellite images of the Amazon rainforest rarely show smoke and cumulus clouds together. Smoke, mainly from agricultural fires, displaces the cumulus clouds that normally form above the forest each afternoon.

Not long after arriving at NASA's Goddard Space Flight Center, Ilan Koren reached a dead end in his first research project, or so it seemed. He was trying to find satellite images over the Amazon rainforest showing heavy smoke from burning vegetation mingling with low-level cumulus clouds. Once he found such scenes, Koren's second objective was to use the satellite data to observe and measure how the smoke particles altered the clouds. The problem was that after spending days combing through NASA's Terra and Aqua data sets, Koren could not find enough examples of smoke mingling with low-level cumulus clouds.

It was November 2002, and Koren had arrived at NASA only 3 months earlier, having just received his doctorate degree from the University of Tel Aviv, where he studied clouds. In school, Koren loved delving into the mysteries of how and why clouds form and change over time. On one level, he appreciated clouds for their beauty. On a deeper level, he recognized their power—clouds regulate the flow of radiant energy into and out of Earth's climate system. "They are nature's way of drawing in the sky the physics of what exactly is going on in the air," he said. "If you can reduce their shapes and patterns to numbers and plug them into mathematical formulas, perhaps you can predict the weather, or even forecast changes in the climate."

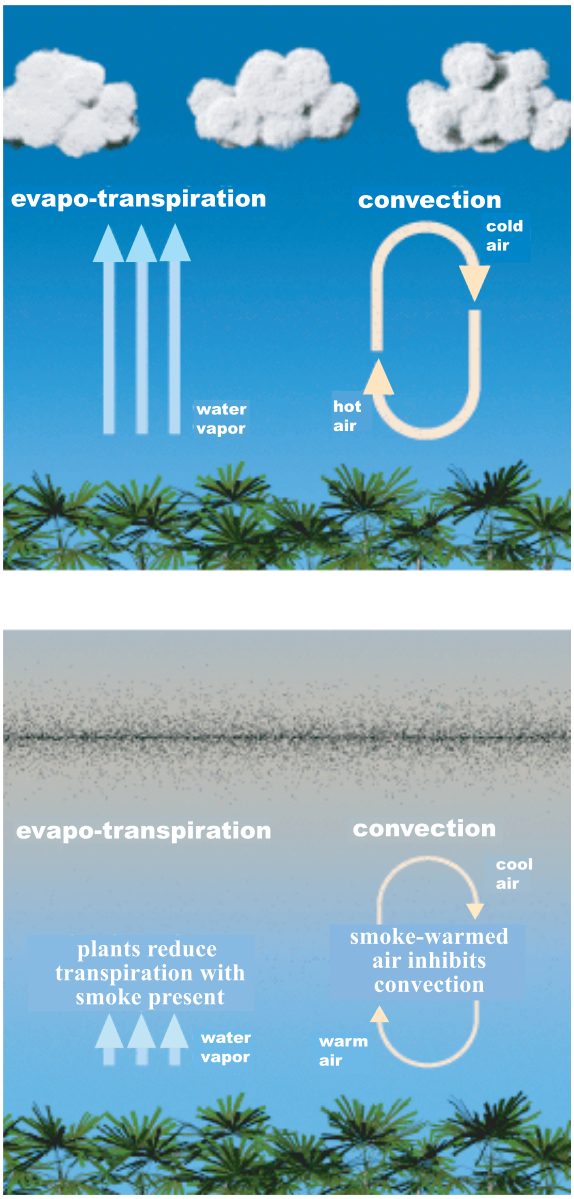
(Continued on page 2)

Abigail's observations illustrate the mission of the S'COOL project: to enable collaboration among students and researchers, advancing students' interest in scientific inquiry, while validating satellite data with the students' ground truth observations. Lin Chambers says, "Scientists benefit from the use of student observations to help validate the CERES measurements. Students benefit from their participation in a real-world science experiment and from their access to a variety of background materials on the S'COOL website, located at http://scool.larc.nasa.gov."

Working with NASA has encouraged Abigail to explore other advanced opportunities for scientific study. This summer she will participate for the third time in the Johns Hopkins Center for Talented Youth (CTY) summer program. Attending a prestigious boarding school in the fall is another opportunity that Abigail has explored to advance her scientific study. This school, Phillips Academy (also called Andover) in Andover, Massachusetts, offers advanced science courses. Recently, Andover's Dean of Admissions gave a speech congratulating the fall class's acceptance to the school, concluding with some of the students' accomplishments. The Dean said, "One girl in our audience has helped to get her school in the top 10 in the world for cloud observations in NASA's Clouds and the Earth's Radiant Energy System Students Cloud Observations On-Line!" Abigail said, "I would have probably never been accepted to Andover, had it not been for S'COOL and CERES."

What might the future hold for this S'COOL kid? The answer may be found in the clouds, or even in the stars. Abigail, just a freshman in high school, already aspires to attend a "science oriented college" such as MIT or Caltech. Abigail hopes to participate in SHARP, NASA's Summer High School Apprenticeship Research Program, before graduating from Andover.

In the meantime, Abigail says she will continue to foster her passion for science by exploring and studying the world around her.



When smoke is present, the dark soot particles absorb sunlight, heating the atmosphere and cooling the surface. This heating reduces relative humidity in the smoke layer, inhibiting the formation of clouds. Furthermore, plants reduce transpiration in response to the smoke, which lowers the amount of water vapor in the air. Because the smoke warms the air above the surface, and simultaneously cools the surface, the difference in temperature between the upper layer of air and air near the surface is reduced, limiting convection, and further discouraging cloud formation.

(Clouds are Cooler than Smoke - Continued from page 1)

So, filled with enthusiasm, Koren joined a team of physical scientists, led by Yoram Kaufman and Lorraine Remer, studying one particular way in which cloud changes influence climate. When tiny particles of pollution in the air (called "aerosols") mingle with certain kinds of clouds they change the clouds' properties, making them whiter, more reflective, and longer lasting, which enhances their ability to shade and cool the surface below them. Dubbed the "indirect effect of aerosols," Kaufman and Remer wanted to find out just how much brightening and prolonging clouds enhanced their ability to reflect sunlight back to space.

"Amazonia [The Amazon Basin] was almost too good to be true," Koren said. "All I had to do was find areas where there was heavy smoke and these clouds. And it was puzzling that I could not find smoke and clouds together. "Completely unexpected, Koren's observation forced the team to step back from their assumptions and shift their attention to the bigger picture. Interestingly, the pattern of where there were no clouds often seemed to match the pattern of where there was smoke. In other words, where there was heavy smoke, the cumulus cloud cover went from an average of about 40 percent to zero!

Could the smoke somehow be suppressing the formation of clouds? Koren suspected the smoke was to blame. He began by turning to the scientific literature to see if any other scientists had observed the same phenomenon and provided an explanation. Koren's search through the scientific literature yielded two leads. In a 1997 paper titled "The Missing Climate Forcing," James Hansen, of NASA's Goddard Institute for Space Studies, and co-authors stated that, on a global scale, aerosols' overall effect is to cool the planet. Even more substantial than aerosols' indirect cooling effect (making clouds more reflective) is the way in which the tiny particles directly scatter and reflect incoming sunlight back to space. Called the "direct effect," aerosols also cool by reducing the amount of sunlight reaching the surface.

Koren's second lead was another paper published in 2000, entitled "Reduction of Tropical Cloudiness by Soot." In that study Andy Ackerman, of NASA's Ames Research Center, and co-authors used a computer model to demonstrate that energy-absorbing aerosols can have a semi-direct affect on cumulus clouds over the ocean. Ackerman described it as the "cloud-burning effect of soot." According to Ackerman, this heating at the top of the boundary layer burns away clouds in two ways: (1) by accelerating the process of evaporation of existing clouds, and (2) by suppressing the upward flow of moisture from the surface needed to form new clouds. The papers confirmed Koren's suspicions about what he observed in the Aqua satellite data acquired over the Amazon Basin—the smoke was suppressing the formation of low-level cumulus clouds.

"We used to think of smoke mainly as a reflector, reflecting sunlight back to space," Koren observed. "But here we show that, due to absorption, it chokes off cloud formation. This is one of aerosols' most important contributions to the global radiant energy budget."

But how could such a small-scale event—and one that only lasts a matter of weeks—possibly have a significant effect on Earth's total energy budget? Remer points out that human production of energy-absorbing aerosols is not unique to the Amazon Basin; the problem is much more widespread and happening year round.

For a complete version of this article visit the Earth Observatory at: http://earthobservatory.nasa.gov/Study/SmokeClouds/

Going Through the LooPlans Lesson

Aerosol Sampler

Objective: Students will work in groups to make an aerosol sampler, a simple adhesive tool that allows students to collect data and estimate the extent of aerosols present in their school community and neighborhoods.

Type of Activity: Application/Extension **Grade Level:** 6-8 (adaptable to other grade levels...see URL below)

Vocabulary: Aerosol, Atmosphere, Biomass burning, Climate, Forest fires, Particles, Sampling, Volcanic eruptions

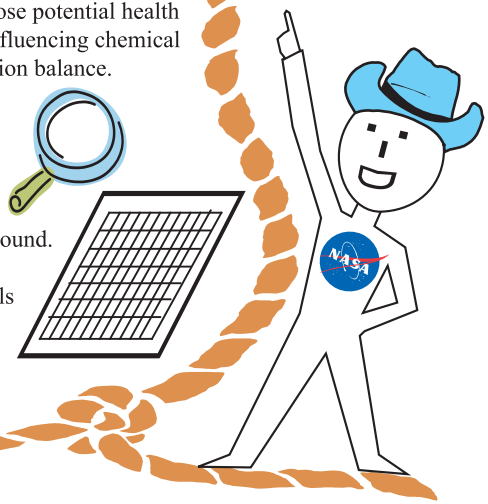
Materials: contact paper, cardboard, tape, magnifying glass, six-sided dice, aerosol sampler grid (provided)

Background: Forest fires, volcanic eruptions, and various other natural events emit enormous quantities of minute particles into the atmosphere. Also, human activities such as biomass burning, vehicular emissions, and industrial processes generate huge amounts of fine particles that are released into the atmosphere. These particles are generally referred to as aerosols. Certain types of aerosols pollute the air, and in some cases pose potential health problems. Aerosols with certain chemical and physical properties are potentially capable of influencing chemical changes in the atmosphere. They may also impact global climate by altering the Earth's radiation balance.

Lesson Activity: This activity can be used as a school site study.

1. Tape contact paper in the center of the cardboard with the sticky side up. Keep protective backing on the paper.
2. Assign each group an area on the school grounds to place their aerosol sampler.
3. Place the aerosol sampler outside on a flat surface, preferably a meter or two above the ground.
4. Remove protective backing from contact paper and let stand for a minimum of 2 hours.
5. Place Aerosol Sampler Grid over the collecting surface and analyze the number of aerosols found on the grid using a magnifying glass.

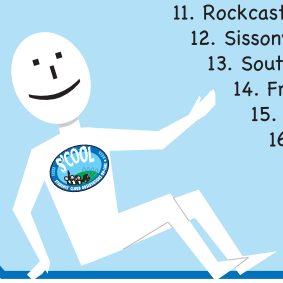
Complete Lesson Plans, Aerosol Sampler Grid and Student Data Worksheets are available at: http://www-sage3.larc.nasa.gov/solar/labactivity-index.html



The 'Matches' Are In!

Over the last several months, a large amount of CERES data have been processed. As a result, we now have 9172 matches between ground observations and CERES measurements. Analysis of these matches led to the Top 20 list below, of those participants with more than 100 matches. A report on this analysis will be presented at a scientific meeting in September. Watch for a Message of the Month on the S'COOL site for information on how you can get a copy of the presentation and written paper. We would like to invite you to do your own analysis on the observations from your location, and to let us know if you find any interesting results.

1. Waynesboro Area High School, Waynesboro, PA
2. Harding Middle School; Cedar Rapids IA
3. Chartiers-Houston Jr./Sr. High School, Houston, PA
4. Jewett Street School, Manchester, NH
5. St. James School, Falls Church, VA
6. Eugenio Maria de Hostos, Mayaguez, PR
7. Collège Les Tamarins, Reunion Island, France
8. Columbia Middle School, Logansport, IN
9. Ecole Primaire Publique, Etrun, France
10. Waiau Elementary School, Pearl City, HI
11. Rockcastle County Middle School, Mt. Vernon, KY
12. Sissonville Elementary School, Sissonville, WV
13. South Butler Primary Center, Saxonburg, PA
14. Francisco Zayas Santana, Villalba, PR
15. Saints Peter and Paul School, Seneca, KS
16. American International School of Budapest, Budapest, Hungary
17. Parrott Middle School, Brooksville, FL
18. Escuela de Biologìa Marina y Laboratoris, Santa Cruz, Argentina
19. Charles Upson Elementary School, Lockport, NY
20. Escuela CROEM, Mayaguez, PR



Teacher Corner

Over 1720 participants are now registered. Keep spreading the word!

Have you changed your school information?
Please remember to notify us of any changes in your school information or e-mail address.

Don't Forget!

Daylight Saving Time CHANGES!
Remember to request your satellite schedule for the new times beginning on November 1st.

The NEW S'COOL Introductory Packet!

Need a little refresher on how to observe for S'COOL, ideas on how to use your archived data or pointers on how to use our website? Well, request your copy by sending us an e-mail with your school name and location to: scool@larc.nasa.gov

Intensive Observation Period - IOP
October 11-15

Thank you for your continued participation!

NASA Langley Research Center
CERES S'COOL Project
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Hampton, VA 23681-2199

Upcoming Events

IGARSS International Symposium
September 20-24, 2004
Anchorage, Alaska, USA

Iowa Science Teachers Conference
October 21, 2004
Des Moines, Iowa, USA

NSTA Midwestern Regional Convention
November 4-6, 2004
Indianapolis, Indiana, USA

NSTA Northwestern Regional Convention
November 18-20, 2004
Seattle, Washington, USA

http://asd-www.larc.nasa.gov/SCOOL/visits.html

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Roberto Sepulveda, Spanish translator

First Impressions

I took a class out to observe clouds for S'COOL (for the first time) and they are in love! They all came in today chattering about the cloud types they observed this weekend, and begging to go out today to observe again. Wait until they hear about contrails!

Kathey Farley, Mabelvale Magnet Middle School; Mabelvale, Arkansas, USA